Design And Fabrication of Solar Powered Drainage Cleaning System

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Abstract- *Waste water is the flow of used water from homes, businesses, industries, commercial activities and institutions which are subjected to the treatment plants. Water is the basic need for the existence of life on earth. In spite of 70% water on earth, majority of water is not suitable for drinking purpose. The chief function of the automatic drainage cleaning system is to collect, transport, as well as dispose the solid waste in the waste bucket by the help of claws. Solid waste in drainage water includes empty bottles, polythene bags, papers etc. Impurities in drainage water can lead to blockage of the drainage system. In order to avoid such situation these impurities are needed to be taken out time to time for the continuous flow of drainage water. The objective of the proposed project work is to design, fabrication and test the efficient working of drainage cleaning system.*

Keywords- Waste water, Impurities, drainage cleaning system, Design, Fabrication

I. INTRODUCTION

Drain cleaner machine is the system installed in an open canal, river or drainage passage so that manual extraction of waste is to be replaced through it. This helps us to prevent the spreading of diseases on humans by manually working in the sewer lines. It overcomes all sorts of drainage problems and promotes blockage free drains by promoting continuous flow of drain water. In the modern era there have been adequate sewage problems where sewage water needs to be segregated to clean our surrounding environment. Our proposed system thus helps to clean and control the drainage level using solar powered auto-mechanism technique.

II. PROBLEM STATEMENT

In today's era, automation plays a very important role in all industrial applications for the proper disposal of sewage from industries and household. Drainage lines are used for the disposal of waste and unfortunately there might be a threat to human life during the cleaning of blockage in the drainage lines or it can cause serious health issues because of pertaining problems like malaria, dengue, etc. In order to overcome this problem as well as to save human life, we implement a design: **"Automatic Drainage Cleaning System"**

To design the proposed test rig in order to use it in an efficient way to control the disposal of waste along with regular filtration of drains, removal of solid waste in order to avoid blockage in drains and to promote continuous flow of drainage water which ultimately reduces the threat to human life.

III. OBJECTIVES

1. To design the various components and other accessories of a proposed test rig.
2. To fabricate the various components and other accessories of a proposed test rig as per the design specifications.
3. To assemble the various components and other accessories of a proposed test rig.
4. To test the proposed test rig for its efficient working and as well proposing the same to overcome conventional method.

IV. LITERATURE SURVEY

Many researchers have carried rigorous exercise related to the drainage cleaning system. Some of them are summarized in this section and are as follows:

Ganesh U L showed the usage of mechanical drainage cleaner to replace the manual work required for drainage cleaning system. Drainage pipes are very dirty. Sometimes it is harmful for human life while it is in need for cleaning drainage system. To overcome this problem, they implemented mechanical semi-automatic drainage water cleaner so that the water flow is efficient because of regular filtration of wastages. Different kinds of environment hazards can be reduced with the help of his drainage system machine.

Elangovan K reviewed about drainage cleaning to replace manual work to automated system because in case of manually

cleaning system it is harmful for human life and to overcome this problem they implemented a design, "Automatic drainage water pump monitoring and control system using "PLC and SCADA". PLC and SCADA were designed in this project to carry out efficient way to control the disposal of wastages regularly by treating of disposal in different ways. PLC controller from Siemens was used in the treatment system of drainage wastewater control by the stepper motor, compressor, gas exhauster, pressure valve and the liquid level, flow and other analog variables to achieve automatic control of sewage waste water treatment.

Dr. K. KUMARESAN explained manual work converted to automated system. Drainage pipe used for disposal may be loss for human life while cleaning the blockage in the drainage pipes. To overcome this problem they implemented "Automatic Sewage Cleaning System". They designed their project in a different way which can separate gaseous substances so that the flow of water is efficient. This project may be developed with the full utilization of men, machines, and materials and money. They made their project economical and efficient with the available resources. They used automation technology concerned with application of mechanical, electronics, and computer based systems to operate and control treatment of wastes.

R.Sathiyakala explained E bucket (electronic bucket) used for drainage cleaning system. E-bucket lifted sewage and used evaporation treatment where wet sewage was converted into dry matters. With the use of ARM board (ARDUINO), this process was performed. After this process they proved that the waste produced were free from any sort of bacteria.

V. METHODOLOGY

The drainage cleaning mechanism is used to take out any floating or sub-floating particles by simply immersing the equipment into the drainage system. Here the mechanism is placed into the drain in such a way that the conveyor portion is placed against the flow of the stream. From our literature surveys, it was found that the drainage system actually did not have any standard dimensions nor they operated using solar power. To cope up and meet these requirements we decided to make our prototype expandable and contractible and solar power operated. This is achieved by inserting side flaps onto the prototype model. The solar panel and the battery are mounted on a pole or a post which will be erected near to the mechanism. Initially the mechanism is kept in the drainage system such that is faces against the flow of stream. As the waste particles floats toward the mechanism, it initially gets obstructed by the mesh provided on the conveyor setup. During this instant the revolving forks picks up the waste particle and dumps it into the collecting tank provided behind the mechanism. The fork is attached to the two sets of chain drives which are driven by a 12V, 8W DC motor. The DC motor is controlled by the 12V, 7Ah battery which supplies the DC powered current continuously to it. The DC battery gets charged via a 12V, 12W solar panel attached near the model. Thus by combining a mechanical and an electrically integrated system we obtain a mechanism that is very much efficient and effective in cleaning the waste particles from the drainage system.

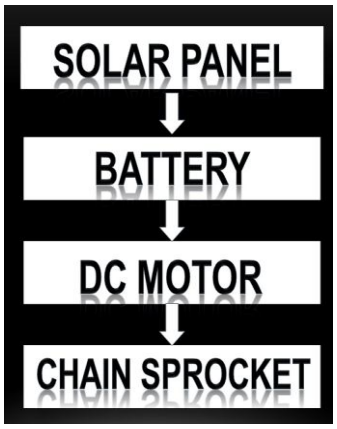


Fig.: Flow diagram of proposed "Solar powered drainage cleaning system"

VI. OBSERVATION

1. DC MOTOR

Continuous torque= 0.2857 kg-cm
Output power= 0.0107HP= 8W
DC voltage= 12V
Continuous current= 1.2A

2. BATTERY (12V, 7Ah)

Standby use= 13.6V-13.8V
Cycle use= 14.1V-14.4V
Max. Initial current= 1.4A

3. Solar panel

Max. Rated power= 12W
Open circuit voltage= 21.6V
Rated voltage=17.6V
Rated current=0.59A

4. Distance between a pair of sprocket (center distance) = 60cm

5. Radius of the sprocket (r)= 3.5cm

6. Angle of inclination of the conveyer system to the base = 40° (approx.)
7. Speed of the motor (N) = 30 RPM

VII. CALCULATION

1. Time motor can run continuously:

(7Ah÷1.41667)= **4.94 hrs**.

2. Time required to charge battery by solar panel at full intensity (i.e., 90°):

= {(12*7) ÷100} =0.84 hrs.

= **50.4 mins**

3. To Calculate Torque developed by motor:

w.k.t, **P = 2πNT/60**

Or, T = (P * 60)/2πN

= (8 * 60) / (2π*30)

= **2.5464 N-m**

4. To calculate amount of Force developed due to this torque:

w.k.t, **T = F * R**

Or, F = T / R = 2.5464 / 0.035

= **72.754 N**

5. To calculate maximum load (in kg) that can be handled by the motor:

w.k.t, **F = M * g**

Or, M = F / g

= 72.754 / 9.81

= **7.416 kg**

VIII. TABULATION

Morning (7-8 a.m.)

	Voltage(in V)	Current(in A)
Solar panel	17.52	0.685
Battery	14.13	3.12

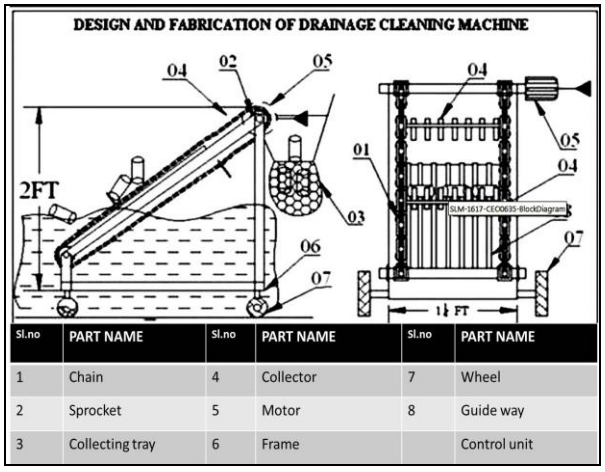
Afternoon (12-1 p.m.)

	Voltage(in V)	Current(in A)
Solar panel	19.9	0.603
Battery	14.31	3.56

Evening (5-6 p.m.)

	Voltage(in V)	Current(in A)
Solar panel	18.01	0.666
Battery	14.23	3.21

IX. DESIGN AND FABRICATION OF PROPOSED MODEL



Sl.no	PART NAME	Sl.no	PART NAME	Sl.no	PART NAME
1	Chain	4	Collector	7	Wheel
2	Sprocket	5	Motor	8	Guide way
3	Collecting tray	6	Frame		Control unit

Fig: 2-Dimensional view of the design representing various parts involved

The major components involved in the design and the fabrication are:

SOLAR PANEL AND BATTERY

India is a country of all seasons with vast quantities of non-conventional sources of energy. We have decided to make use of the solar energy to power up our prototype, so we adopted a 12V, 10W solar panel. This panel is used to charge a 40Ah battery. This will give us sufficient charge to run the motor for the required time and at the required loading conditions.

DC MOTOR

A 12V DC motor is adopted to produce the desired amount of torque for varying loads. The motor is attached to a driving shaft, which gives motion to a conveyor system for smooth functioning of the system.

CONVEYER MECHANISM

The motor is coupled to the driver shaft. The driver shaft is connected to a driven shaft via 2 sets of chains and 4 sets of sprockets, which completely acts as a conveyor mechanism. The forks are then linked to each set of chain drives on the either side, thus we obtain a conveyor motion for the forks.

FORK

The forks acts as rake in collecting the floating and sub floating particles in the drain and carry them to the collecting basket. For instance, the fork attached may carry various waste bottles, husks, plastics, cloth, etc.

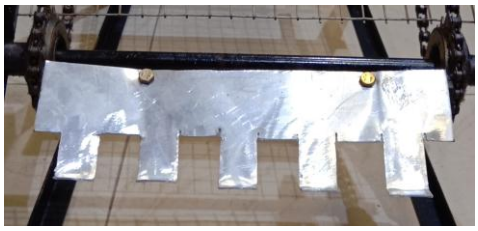


Fig: Fabricated "Solar powered drainage cleaning system"

ADVANTAGES

- Production cost is very low.
- It is compact and portable.
- No skilled labor is required for operation.
- Low maintenance cost.

DISADVANTAGES

- Vibrations produced within the system affects the overall efficiency of the cleaner.
- Metal parts of the cleaner tend to rust due to direct contact with the fluid.

APPLICATIONS

- It is used almost in all types of drainage (Large, Small, and Medium).
- Project to use this in efficient way to control the disposal of wastages and with regular filtration of wastages.
- Cleaning and maintenance of sewer lines drains of mechanical drainer.

EXPECTED OUTCOME

Automation is a technology concerned with the application of mechanical, electronic and computer based systems to operate and control production.

- The proposed system can be used to operate automatic sewage cleaning equipment.
- The proposed system can be economical and efficient with the available resources.

X. CONCLUSION

Water is a basic necessity of humans and all living beings. There is plenty of water on earth but all of it is not suitable for human use. The impurities present in water are proven hazardous and may even cause death. This technology is applied on our sewage lines. Also we have followed thoroughly the study of time, motion and made our project economical and efficient with the available resources. The system is made more efficient by the use of solar energy. This system was designed, fabricated and also tested successfully. It works satisfactorily. Thus we have developed this concept of "Solar powered drainage cleaning system".

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